LARVAL DEVELOPMENT OF THE SAND CRAB EMERITA TALPOIDA (SAY) IN THE LABORATORY [1,2]

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Present knowledge of the larval development of *Emerita talpoida* (Say) is limited to two early reports, both under the generic name *Hippa*. Smith (1877) described three zoeal stages, which he called second, third, and last zoea, and a megalops stage, all from the plankton of Vineyard Sound, Mass. Smith was unable to obtain a first zoea, as females brought into the laboratory invariably cast off their eggs before they hatched. Faxon (1879a) was able to obtain the first zoea from eggs hatched in the laboratory. He was unable to rear any larvae through the first molt into the second stage, but ventured the opinion that one or more stages remained to be discovered between the first and the earliest described by Smith.

The larvae of two other species of *Emerita* have been investigated, *Emerita asiatica* by Menon (1933), and *Emerita analoga* by Johnson and Lewis (1942). Johnson and Lewis were able to obtain the first zoea from eggs hatched in the laboratory, but were unable to maintain the larvae through the first molt. One individual did enter the second stage after 34 days, but died soon afterwards. On the basis of the first zoea obtained in the laboratory and other stages from the plankton, Johnson and Lewis describe five zoeal stages. In addition, they state that a number of specimens were collected which appeared to be intermediate between Stage III and Stage IV, and which they called, for convenience, "Lower Stage IV." Menon (1933) lists five zoeal stages for *Emerita asiatica*, all of which were obtained from the plankton.

The present paper is a description of the larval development of *Emerita talpoida* (Say) based on observations of larvae reared in the laboratory.

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Methods

Ovigerous females of *Emerita talpoida* were collected on the beach at Fort Macon, N. C., and held in the laboratory in large fingerbowls until hatching occurred. If unmolested, the females remained quiet in the fingerbowls until the time of hatching. At this time they became active and swam in short spurts around the sides of the container. At each spurt of swimming activity a cloud of

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larvae was released. The larvae began actively swimming immediately upon hatching, with no intervening prezoeal stage.

Groups of ten newly hatched larvae were placed in four-inch fingerbowls of sea water which had been filtered through glass wool and inoculated with 200,000 units of penicillin per liter. There were ten such bowls. Other larvae were reared in mass cultures in fingerbowls containing approximately 200 individuals each. Each day the larvae were transferred by means of a pipette to clean bowls of filtered, inoculated sea water. To each bowl each day was added a quantity of *Nitzschia* sp. and newly hatched *Artemia* nauplii. The exception to this was one of the mass culture bowls, to which only *Nitzschia* sp. was added. The zoea were observed to capture and feed upon the *Artemia* nauplii quite readily.

The fingerbowls which originally contained ten larvae each were examined daily and a record made of the number of individuals surviving and the number in each stage of development each day, based upon exuviae found. Larvae in each stage were removed from the mass culture dishes and preserved in 70 per cent alcohol.

Throughout the experiment the larvae were maintained at a temperature of 30.0° C. and under constant illumination from daylight fluorescent lights. The sea water in which the larvae were reared varied in salinity from 28.2 parts per thousand to 35.1 p.p.t., with a mean of 32.2 p.p.t.

Results

In the mass culture dish to which only *Nitzschia* sp. was added all individuals died while still in the first zoeal stage. In the other bowls, to which newly hatched *Artemia* nauplii were added in addition to *Nitzschia*, some of the individuals eventually entered the megalops stage after passing through six or seven zoeal stages. The majority of the individuals which became megalops did so after passing through six distinct zoeal stages; a few individuals went through an additional molt between the sixth zoeal stage and the megalops. The only morphological difference apparent between the sixth zoeal stage and the seventh zoeal stage was an increase of one or two setae on the exopods of the maxillipeds. The appearance of a seventh zoeal stage in a few individuals does indicate, however, that the number of molts through which an individual passes during larval development is not fixed and/or inflexible.

The number of individuals which entered each stage and the average duration of each stage are given in Table I. Although a few deaths occurred during the intermolt period, most of the individuals which died did so at the time of molting. The difficulty in molting was usually the result of the old exuvia adhering to the new exuvia, generally on the maxillipeds and near the tip of the rostral spine. This failure of the old exuvia to detach from the new may be due to a physiological weakness existing in some of the zoea. Whether this weakness also exists in nature is a matter for speculation.

The shortest length of time that it took any individual to become a megalops was 23 days, the longest was 33 days. The average length of the pelagic larval life in the laboratory was 28 days.

With each zoeal molt the number of setae on the exopods of the first and second maxillipeds increased by either one or two. This change in the number of setae

TABLE I

Number of individuals out of the original 100 which entered each stage of development and the average duration of each stage

Stage	I	II	III	IV	V	VI	VII	Megalops
Number of individuals	100	94	75	71	63	45	5	15
Average number of days spent in stage	3	4	3	4	5	9	3	

on the maxillipeds was found to be an accurate indication of the number of molts through which an individual reared in the laboratory had passed.

DESCRIPTION OF THE LARVAE OF E. TALPOIDA

FIRST ZOEA (FIG. 1)

The first zoeal stage is similar to the first stage of *Emerita asiatica,* as described by Menon (1933), and *E. analoga,* as given by Johnson and Lewis (1942). The smoothly rounded carapace is translucent, colorless, and without the lateral spines which are characteristic of subsequent stages. The rostrum is short and broad. The eyes are stalked. The eyestalks are short and thick and lie close against the carapace, directed somewhat posteriorly. The abdomen projects almost straight downward from the carapace and is flexed so that the telson is carried beneath and nearly parallel to the carapace. The exopods of the maxillipeds bear four plumose setae.

Antennules (Fig. 8). These short, unjointed appendages are thick at the base and taper to a blunt point where three setae of about equal length are borne. These setae are slightly longer than the body of the appendage.

Antennae (Fig. 14). The antennae at this stage are rather stubby appendages, produced on the outer side into a spine-like process. From the base of the outer spine there arises a somewhat slenderer dentiform process of about the same length. At the base of this inner process there is a much smaller spine. The form of the antennae is relatively unchanged through the first four zoeal stages, the first indication of a flagellum not appearing until the fifth zoeal stage.

Mandibles (Fig. 20). The mandibles grow out ventrally and then make a

TABLE II

Relative size of larvae in each stage reared in the laboratory. Based on average measurements of 10 or more specimens. Dimensions are given in mm.

Stage	I	II	III	IV	V	VI	Megalops
Max. length of carapace	0.57	0.68	0.88	1.13	1.60	1.90	2.30
Max. width of carapace	0.46	0.56	0.67	0.84	1.00	1.30	1.80
Length of abd. plus telson	0.80	0.84	1.30	1.50	1.80	2.40	1.90
Length of rostrum	0.20	0.68	1.27	1.55	2.40	2.90	—
Length of lateral spine	—	0.30	0.44	0.60	0.80	1.00	—

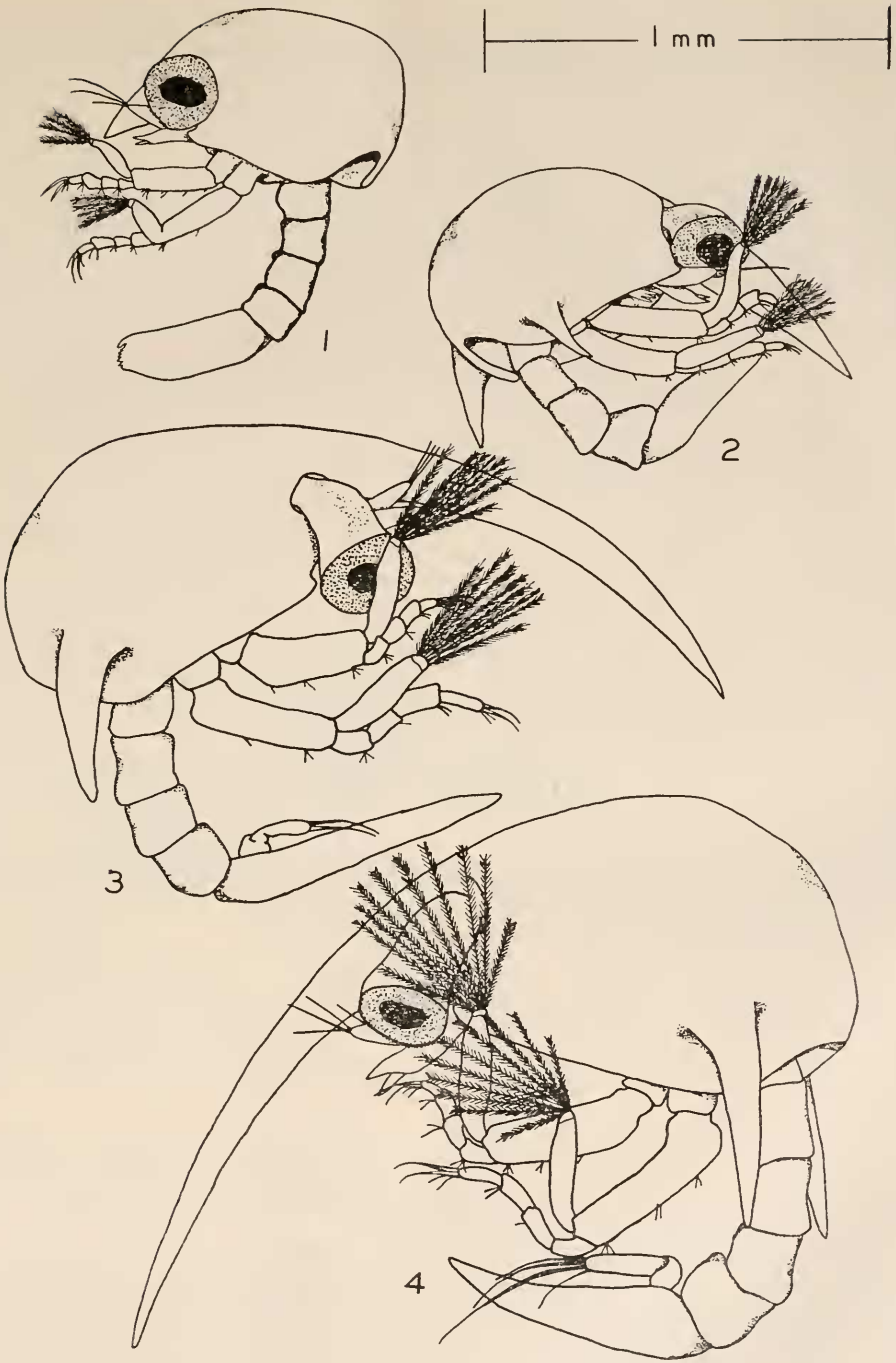


FIGURE 1. First zoea.
FIGURE 2. Second zoea.
FIGURE 3. Third zoea.
FIGURE 4. Fourth zoea.

right angle bend towards the median line so that their crowns are opposed. The crown is armed on its ventral edge by a stout, rather blunt tooth, followed by two shorter, sharp, triangular teeth. Next, there are three or four long slender, setae-like teeth and, finally, a sharp, triangular tooth on the dorsal edge. The entire crown slopes gradually from the ventral to the dorsal edge. These appendages change very little, except for a general increase in size, throughout the zoeal stages.

First maxillae (Fig. 22). These are fleshy appendages, adapted for handling food. The endopod bears three stiff setae at its tip and one short seta about halfway down its inner side. The exopod is twice as large as the endopod and flattened dorso-ventrally. It is divided at its distal end into two tapering horns. Part way down the outer side of the exopod is a small lobe, bearing a single long, curved seta.

Second maxillae (Fig. 24). Each of these appendages is divided into two parts. The protopod is a lobe, tapering anteriorly, where it bears a cluster of three setae. The scaphognathite is sickle-shaped, broader posteriorly than anteriorly, and very thin and foliaceous. Along its anterior-outer margin are nine setae. The posterior and inner margins of the scaphognathite are naked.

First maxillipeds (Fig. 1). These appendages are composed of a short coxopod, a long basipod, a two-segmented exopod and a four-segmented endopod. The basipod bears a group of three setae on its posterior margin just behind the joint with the endopod. One of these setae is shorter and stouter than the other two and armed with minute spines. Behind these is a group of two setae, then a short distance back, a single seta, and finally a single seta close to the joint with the coxopod. The endopod consists of four, cylindrical segments, each bearing setae. The first segment bears three setae just below the joint. One of these is shorter and stouter than the other two and armed with minute spines. The second segment bears two setae just below the joint, one of which is short, stout, and armed with spines as above. The third segment has two setae below the joint. The terminal segment bears four setae at its tip. The outermost two are the longest, curve downward at the ends and bear small spines along their inner margins. The exopod consists of a proximal segment as long as the endopod and a very short terminal segment which bears four long, plumose setae.

Second maxillipeds (Fig. 1). These are very similar to the first maxillipeds except the endopod is somewhat longer than the exopod. The basipod bears three setae along its inner margin; a group of two just behind the joint with the endopod and a single seta about halfway between this and the joint with the coxopod. No rudiments of other thoracic appendages are visible posterior to the second maxillipeds at this stage.

Abdomen. The abdomen is composed of five segments, the first of which is not clearly differentiated from the abdomen at this time. The sixth segment is consolidated with the telson; this becomes apparent when the uropods appear. No rudiments of abdominal appendages are visible.

The telson is slightly broader than long, and faintly concave. The lateral margins curve smoothly to a stout tooth at each side of the posterior margin. The posterior margin of the telson is armed with a complicated series of small spines, with minute denticles between them. The eighth spine from each side is the longest, and between these two longest spines are either nine or ten spines of intermediate length. Thus, in some cases there are twenty-five spines on the

posterior margin and in others there are twenty-six. This arrangement holds true for all the zoeal stages, there being sometimes twenty-five and sometimes twenty-six spines on the posterior margin of the telson.

Second Zoea (Fig. 2)

Two lateral spines are now present on the carapace, projecting posteriorly and downward. The rostrum has increased in length tremendously and is now as long as the carapace. The eyestalks are longer and the eyes are carried somewhat farther forward than in the first stage. The exopods of the maxillipeds bear six plumose setae.

Antennules (Fig. 9). Each of these appendages now bears a single stout seta instead of the three which were present in the first stage.

Antennae (Fig. 15). These are the same as in the first zoea.

Mandibles. As in the first zoea.

First maxillae. As in the first zoea except that the exopod bears three long teeth, the outer one showing no articulation at the base.

Second maxillae. As in the first zoea.

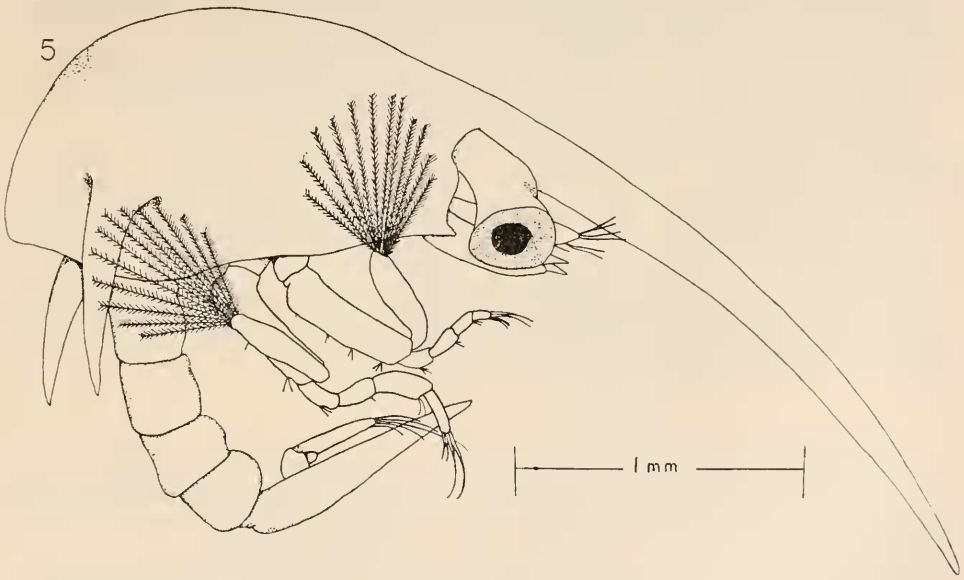


Figure 5. Fifth zoea.

Third Zoea (Fig. 3)

The shape of the carapace has changed somewhat. In the first zoea the carapace is practically hemispherical, in the second zoea it is less so, and now in the third zoea, its lateral outline is pear-shaped. The rostrum has continued to lengthen in comparison to the carapace and now exceeds the length of the carapace. Uropods appear on the telson. The exopods of the maxillipeds bear eight plumose setae.

Antennules (Fig. 10). Each of these bears three setae at its tip, much as in the first zoea stage.

Antennae (Fig. 16). As in the first and second zoea.

Mandibles. As in preceding stages.

First maxillae. As in the second zoea.

Second maxillae. As in the first and second zoea, the number of setae on the scaphognathite is nine.

Maxillipeds. The exopods bear eight plumose setae.

Uropods. These appear on the anterior ventral surface of the telson and consist of a short basal segment with a long, flattened lobe extending from it. This lobe is the exopod, as will be seen from later development, and bears two long setae at its tip.

The eyestalks have enlarged and project downward and forward. There is no evidence of any additional thoracic or abdominal appendages at this stage.

Fourth Zoea (Fig. 4)

This stage is characterized by the presence of ten plumose setae on the exopods of the maxillipeds and the fact that the uropod bears four setae on its exopod.

Antennules (Fig. 11). Each of these appendages bears four setae, three at the tip and one a short distance down on the inner side.

Antennae (Fig. 17). These are unchanged except for general growth.

Mandibles. These are somewhat slenderer than in preceding stages.

First maxillae. As in preceding stages.

Second maxillae. There are fourteen setae on the anterior-outer margin of the scaphognathite.

Maxillipeds (Fig. 4). These bear ten plumose setae at the tips of the exopods.

Uropods. The exopod bears two long and two short setae. No evidence of endopod as yet.

Abdomen. Each of the four free segments of the abdomen bears two small, round thickenings on its inner side, the evidence of future pleopods. No additional thoracic appendages are visible through the carapace.

Fifth Zoea (Fig. 5)

The fifth zoea is characterized by the presence of eleven or twelve plumose setae on the exopods of the maxillipeds, and the appearance of the rudiment of the endopod on the uropods. The rudiments of five future thoracic appendages are now visible through the carapace, posterior to the second maxillipeds.

Antennules (Fig. 12). Each bears six setae; a group of three at the tip, a group of two lower down on the inner margin and a single seta below these.

Antennae (Fig. 18). The rudiment of the flagellum is visible as a conspicuous knob, about half as long as the dentiform process, on the inner side of the antenna.

Mandibles. As in preceding stages.

First maxillae. As in preceding stages.

Second maxillae (Fig. 25). The number of setae along the anterior-outer margin of the scaphognathite has increased to nineteen.

Maxillipeds (Fig. 5). There are eleven or twelve plumose setae on the tips of the exopods. In the first four stages the number of setae on the exopods was

constant at four, six, eight, and ten, respectively; now there is some variation. Although twelve appears to be the more usual number, about one-third of the specimens examined had eleven setae on one or more of the maxillipeds. Individuals were found with twelve setae on the first maxilliped of the right side and eleven on the first maxilliped of the left side, and vice versa. This was also found to be true for the second maxillipeds. No individuals, in this stage of development, were found with less than eleven or more than twelve setae on the exopods of the maxillipeds.

Abdomen. As in the fourth zoea.

Uropods. The rudiment of the endopod now appears as a small bud below the exopod. The exopods have increased in length and each now bears five long setae at its tip.

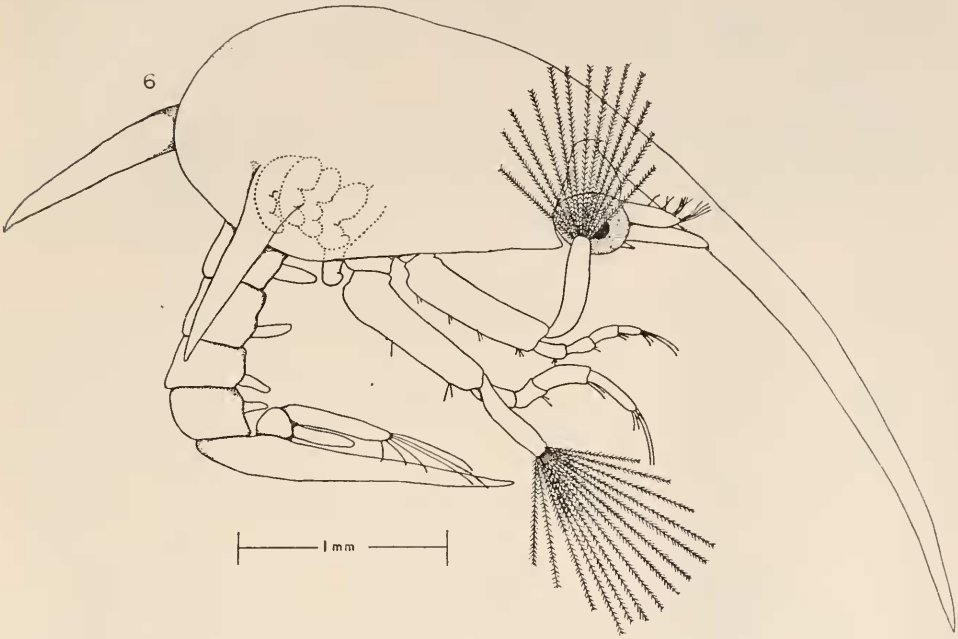


FIGURE 6. Sixth zoea.

SIXTH ZOEA (FIG. 6)

There are now uniramous pleopod buds on the four free segments of the abdomen. The exopods of the first and second maxillipeds bear thirteen or fourteen plumose seta. The rostrum continues to increase in length relative to the carapace and is one and one-half times the length of the carapace.

Antennules (Fig. 13). These appendages bear eleven setae in four groups: four at the tip, a group of four below this, a group of two below that, and finally a single seta below these.

Antennae. The flagellum has increased enormously, dwarfing the dentiform processes and extending well beyond the antennule.

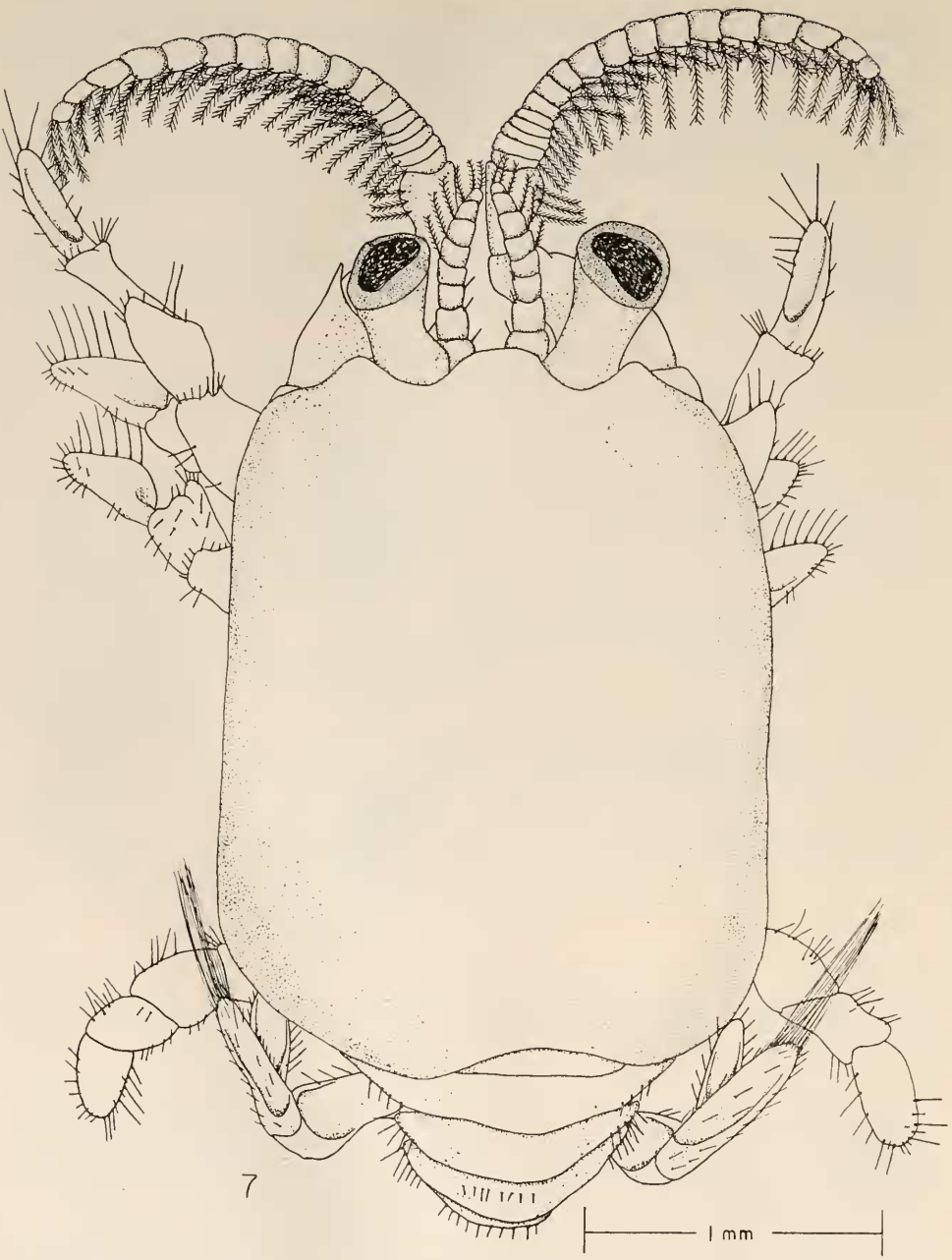


FIGURE 7. Megalops.

Mandibles (Fig. 21). The crown is armed much as in previous stages, but the shaft of the mandible is not so stout in proportion to its length.

First maxillae (Fig. 23). As in preceding stages.

Second maxillae. There are now 29 setae which extend all the way around the anterior-outer margin of the scaphognathite.

Abdomen. A pair of uniramous, unsegmented pleopods now appears on the second through the fifth segments of the abdomen.

Uropods. The endopod has increased considerably and is now two-thirds the length of the exopod. The exopod bears six setae of unequal length at its tip.

Maxillipeds (Fig. 6). The number of plumose setae on the exopods is now thirteen or fourteen occurring with about equal frequency. No individuals were found with less than thirteen or more than fourteen.

Five thoracic limb buds are plainly visible through the carapace. The first of these is the largest and extends below the edge of the carapace. This is the rudiment of the third maxilliped. The rudiment of the fifth pereiopod is not visible at this time.

Most of the individuals which became megalops did so at the molt following this stage. A few, however, went to a seventh zoea before becoming megalops. The only difference between this seventh zoea and the sixth was the appearance of additional setae on the maxillipeds, making the number fifteen or sixteen.

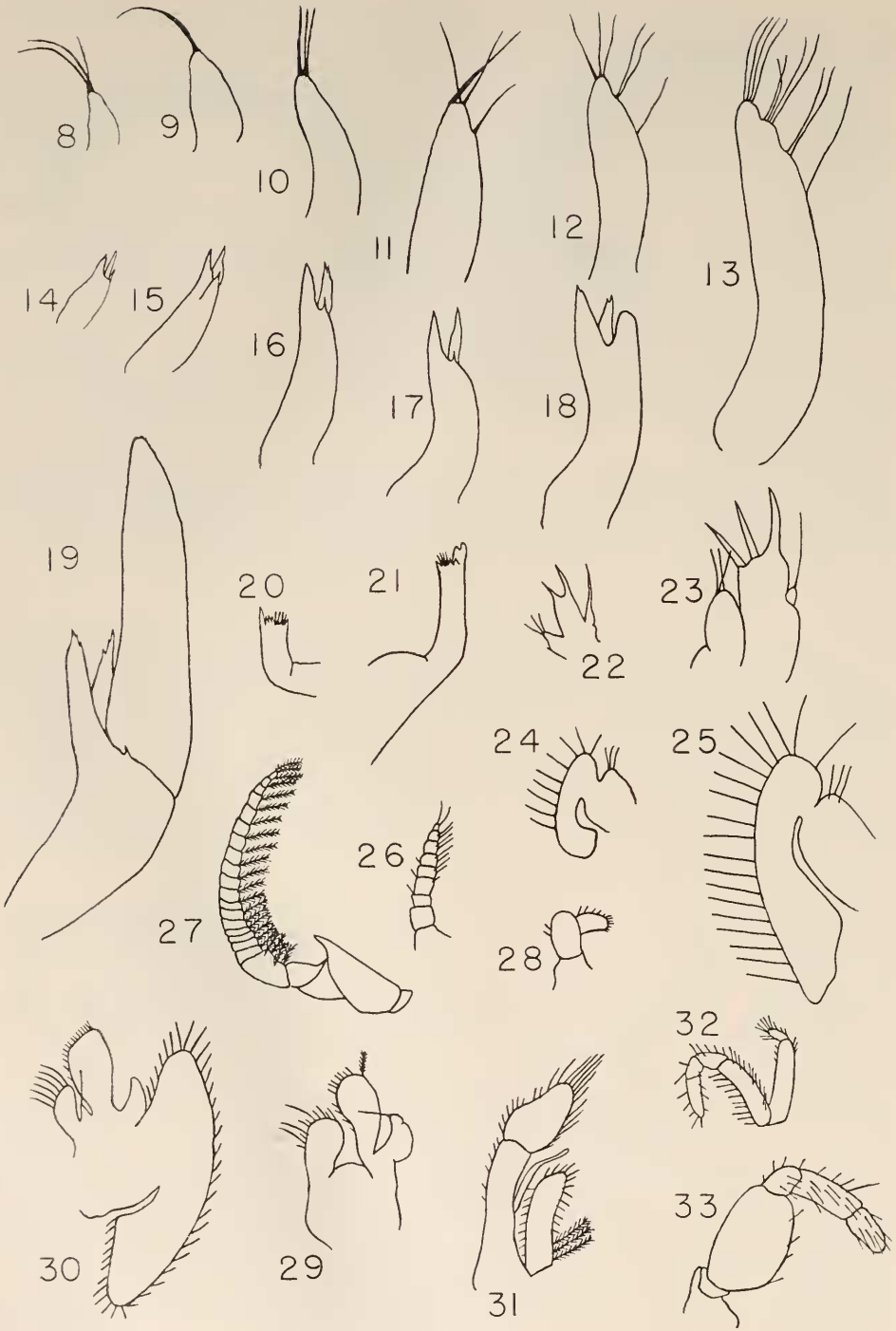
Megalops (Fig. 7)

In general form the megalops resembles the adult, the most obvious difference being that the eyes are still relatively large and the abdomen bears four pairs of pleopods which are quite unlike those of the adult. The megalops carries the abdomen flexed, with the telson between the bases of the pereiopods, though it is not as strongly flexed as in the adult. In swimming the megalops sometimes, but not always, extends the abdomen, thus utilizing the pleopods as swimming appendages. This tendency to swim with the abdomen extended decreased with time and individuals which had been in the megalops stage as long as one day were rarely seen to extend the abdomen.

Antennules (Fig. 26). These appendages are now as long as the peduncles of the antennae and composed of three basal segments and a six-segmented flagellum, which is not noticeably delineated from the basal segments. The first segment bears one, and the succeeding five segments each bear two plumose setae on the outer margin. The segments of the peduncle and the two lower segments of the flagellum may bear a single seta on the inner side. The secondary flagellum of the adult is not present at this stage.

Antennae (Fig. 27). These now possess all the important features of the adult form. There is a scale-like exopod and an endopod composed of three segments and a long flagellum. The flagellum is stout, tapers gradually to a rather blunt tip, and is composed of eighteen segments. The segments are short proximally but gradually increased in length distally until they are longer than broad near the tip. Each segment bears four setae. There are two long, plumose setae which curve inward at their tips, and within these are two shorter, straight, unarmed setae.

Mandibles (Fig. 28). The mandible has undergone a complete change in structure and function. It is no longer an organ of mastication but is adapted, as in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FIGURES 8–33.

the adult, for the purpose of scraping the antennae and passing food to the mouth. The mandible is now composed of two parts, a broad, foliaceous outer lobe bearing two short, stout setae on its lateral margin, and an inner palp fringed with setae along its anterior and median margins. A very noticeable difference between the appendages of the megalops and those of the adult is the relatively sparse setation of the megalops appendages. In the adult all the appendages are densely fringed with setae.

First maxillae (Fig. 29). The first maxillae now possess all the parts of the adult appendage. The inner lobe (endopod) is broad, bluntly rounded at the tip and armed with stout setae of varying length around the tip and part way down the inner margin. The outer lobe (exopod) is longer and much narrower at the base but broad and round at the tip. It is armed with short, stout setae at the tip and along the inner margin. There is one long plumose seta at the beginning of the outer margin. The palpus is a sac-like lateral projection near the base of the inner lobe. It bears a single long seta at its tip.

Second maxillae (Fig. 30). These appendages are like the adult form except for the relative proportions of the endites and the sparsity of setae as compared to the adult. In the megalops the endites compose three lobes, a small inner lobe bearing long curved setae down its inner margin, a much larger outer lobe fringed with short setae along its anterior-inner margin, and a small papiliform lobe between these two, bearing a single long seta. Between the outer endite and the scaphognathite is a small, triangular lobe representing the endopod. The scaphognathite is broad, thin and has much the same form as in the zoeal stages. It now tapers more acutely anteriorly and the fringe of setae has extended around the broad posterior margin.

First maxilliped (Fig. 31). The anterior segment of the protopod is elongated into a flat, blade-like process bearing setae around its margins, with a series of much longer, plumose setae on the posterior portion of the inner margin. The endopod is represented by a soft, slender lobe arising from near the base of the inner side of the two-segmented exopod. The exopod consists of a long basal segment bearing short setae along its outer margin, and a shorter, broader, paddle-shaped terminal segment bearing very long setae at the tip and shorter setae along its other margins.

Second maxillipeds (Fig. 32). The four-segmented endopod of the second maxilliped differs slightly from the adult form. The third segment makes a right angle bend in the adult, while it is practically straight in the megalops, and the terminal segment is proportionally much shorter and stouter in the megalops than in the adult. The exopod is two-segmented; the basal segment does not taper anteriorly as acutely as in the adult and the oval terminal segment is proportionally smaller in the megalops than in the adult. As in previous cases, the adult appendage is very heavily fringed with setae, while in the megalops the setae are shorter and much sparser.

FIGURES 8–13. Antennule, first to sixth zoea.
FIGURES 14–19. Antenna, first to sixth zoea.
FIGURE 20. Mandible, first zoea.
FIGURE 21. Mandible, sixth zoea.
FIGURE 22. First maxilla, first zoea.
FIGURE 23. First maxilla, sixth zoea.
FIGURE 24. Second maxilla, first zoea.
FIGURE 25. Second maxilla, fifth zoea.
FIGURE 26. Antennule, megalops.
FIGURE 27. Antenna, megalops.
FIGURE 28. Mandible, megalops.
FIGURE 29. First maxilla, megalops.
FIGURE 30. Second maxilla, megalops.
FIGURE 31. First maxilliped, megalops.
FIGURE 32. Second maxilliped, megalops.
FIGURE 33. Third maxilliped, megalops.

Third maxillipeds (Fig. 33). These broad, opercular appendages bear a three-segmented palp at their distal end. The rounded prominence at the articulation of the palpus is lacking in the megalops. The palpus is stouter and the terminal segment much shorter than in the adult.

Pereiopods. The pereiopods are so much like those of the adult that a detailed description of them is unnecessary. The first, second, and third pairs project anteriorly; the fourth pair projects posteriorly and, like the first three pairs, is especially adapted for burrowing in the sand. The fifth pair of pereiopods are very slender, chelate appendages, which are held concealed within the branchial cavity.

Abdomen. The abdomen is, for the first time, composed of six segments, similar in form and proportion to those of the adult, and a triangular telson. The first segment, as seen dorsally, is a small plate, filling a curved sinus in the posterior margin of the carapace. The second segment is the largest of the abdominal segments and is about five times as wide as it is long. Its width is due to a broad lamellar expansion on each side. The third, fourth, and fifth segments are rounded at the outer margins and each is slightly shorter and narrower than the one before. The sixth segment is nearly as wide as the fifth and is as long as it is wide, being the longest of the abdominal segments. The second, third, fourth, and fifth segments of the abdomen each bear a pair of biramous pleopods. The pleopods are made up of three portions; a long basal segment, a paddle-shaped exopod and a knob-like endopod. The pleopods of the second and third segments bear ten plumose setae each on the exopods and those of the fourth and fifth segments bear eleven plumose setae on the exopods. The small endopods increase in length successively from the first to the fourth pleopod, and bear at their tips a series of small hooks. These hooks can engage those of the endopod opposite it, thus joining the pair of pleopods so that they move as one.

Uropods. The appendages of the sixth abdominal segment are essentially the same as those of the adult. There is a two-segmented protopod, the proximal segment of which is short and round and the distal segment, much longer, stouter and flattened. The exopod and endopod are nearly alike: oval, broadly rounded at the tip and fringed with setae which are very long at the tips but shorter along the sides.

Discussion

The first zoea of *Emerita talpoida*, obtained from the egg, corresponds with the first zoea described by Faxon (1879a). The larvae described by Smith (1877) from the plankton as the second, third, and last zoea do not correspond exactly with any of the zoeal stages reared in the laboratory. The results of the present experiments indicate that each zoeal molt results in an increase in the number of setae borne on the exopods of the first and second maxillipeds. In the laboratory their number never increased by more than two setae at any one molt. Using the number of setae on the maxillipeds as an indication of the number of times that an individual has molted, Smith's three zoeae correspond to the third, fourth, and fifth zoeal stages reared in the laboratory. In each case, however, the zoeae from nature possess features (appearance of thoracic limb buds, pleopods, etc.) which show them to be farther advanced in development than the corresponding laboratory stages.

Smith's last zoeal stage bears twelve setae on the exopods of the first and second maxillipeds. A number of individuals in this stage were observed by Smith to change to megalops at a single molt. If setation of the maxillipeds is an accurate index to the number of zoeal molts, then these individuals from nature completed their larval development in five molts, whereas those in the laboratory went through six or seven molts before becoming post-larvae.

Gurney (1942) has questioned the normality of larvae reared in the laboratory and believes that abnormal stages may be reared under artificial conditions. However, Gurney also states that extra stages, through which each individual need not pass in development, occur in nature. Other references to these extra stages have been made by Faxon (1879b), Lebour (1940), Gurney and Lebour (1941), and Broad (1957a). Johnson and Lewis refer to a "Lower Stage IV" in the larvae of *E. analoga,* which was intermediate between Stage III and Stage IV. They could not say whether this was a distinct instar or simply a variable in Stage IV. This is apparently another case of a stage in larval development through which not all individuals pass. If each larval form found in the development of a decapod is described as a stage, then we may expect to find individuals who skip stages or pass through extra stages in the course of normal development, depending upon the number of stages previously defined.

Broad (1957b) working with *Palaemonetes* larvae, has shown that a direct relationship exists between the diet of the larvae and the rate of larval development and frequency of molting. His results show that larvae may respond to suboptimal conditions of diet by a prolonged larval life and a greater number of larval intermolts. It is probable that a number of other environmental factors also affect the tempo of larval development, and that normal development of *Emerita* and other decapods varies according to the variations in trophic conditions during the breeding season.

Summary

1. *Emerita talpoida* were reared in the laboratory from eggs to the megalops. Of individuals hatched in the laboratory 15 per cent survived to the megalops.

2. The average length of time required to pass through the pelagic larval stages in the laboratory was 28 days. A table is given which shows the average duration of each of the zoeal stages.

3. Six zoeal stages and a megalops are figured and described. A seventh zoeal stage, which was skipped by most of the larvae, is described.

4. Larvae reared in the laboratory are compared with three zoea stages described from the plankton by Smith.

5. The larval development of *Emerita talpoida* should not be regarded as consisting of a fixed number of stages determined by a fixed number of larval intermolts.

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